LASER INDUCED BREAKDOWN SPECTROSCOPY (LIBS)

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ARMY RESEARCH LAB ABERDEEN PROVING GROUND

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Objective

Field portable or remotely operated sensor for close stand-off detection of chem/bio agents, explosives, mines, contaminants, etc.

What is LIBS?

Laser Induced Breakdown Spectroscopy (LIBS) is basically a simple spark spectrochemical technique which has broad capability for chemical analysis.

In order to do LIBS one needs-

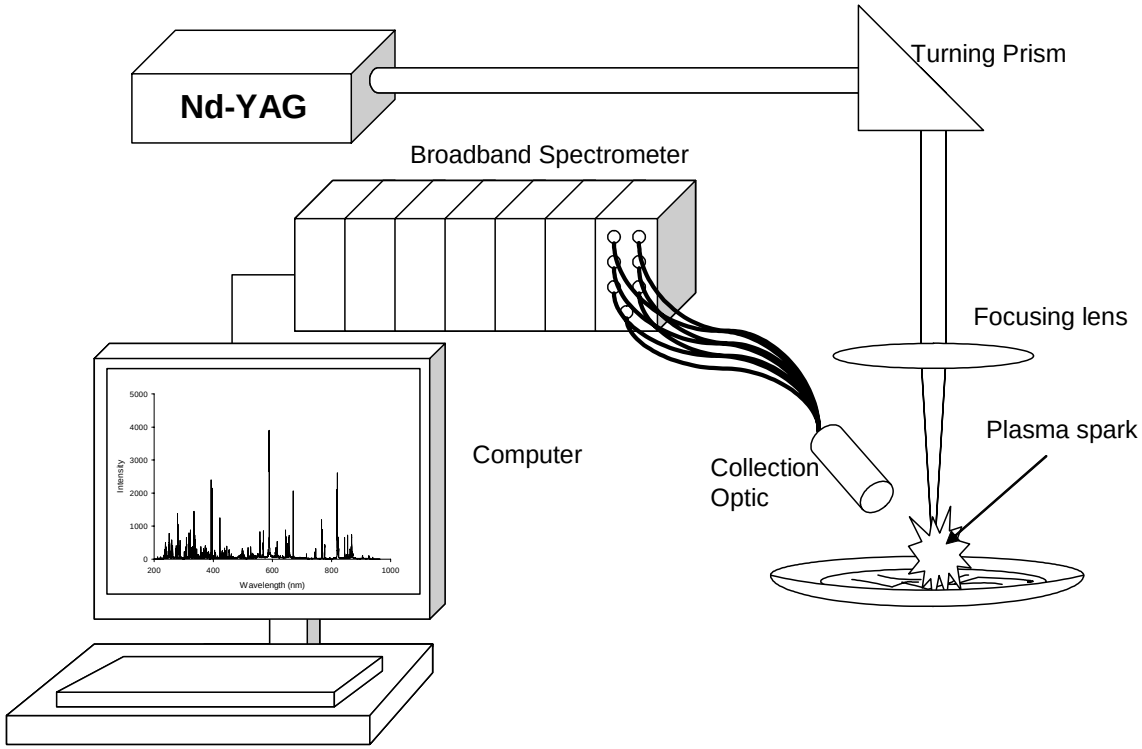
- Short pulse (20 ns or faster) laser with a minimum of 10 mJ per pulse.

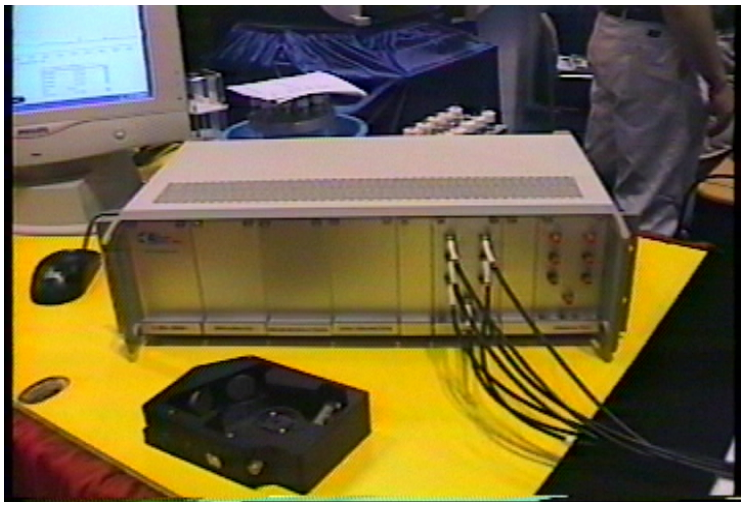
- Optics for laser light delivery/focussing.

- Optics for capturing the light emitted from the spark.

- Spectrometer/detector to separate the light from different elements and ions for chemical identification and quantification.

LIBS Experimental Set-up

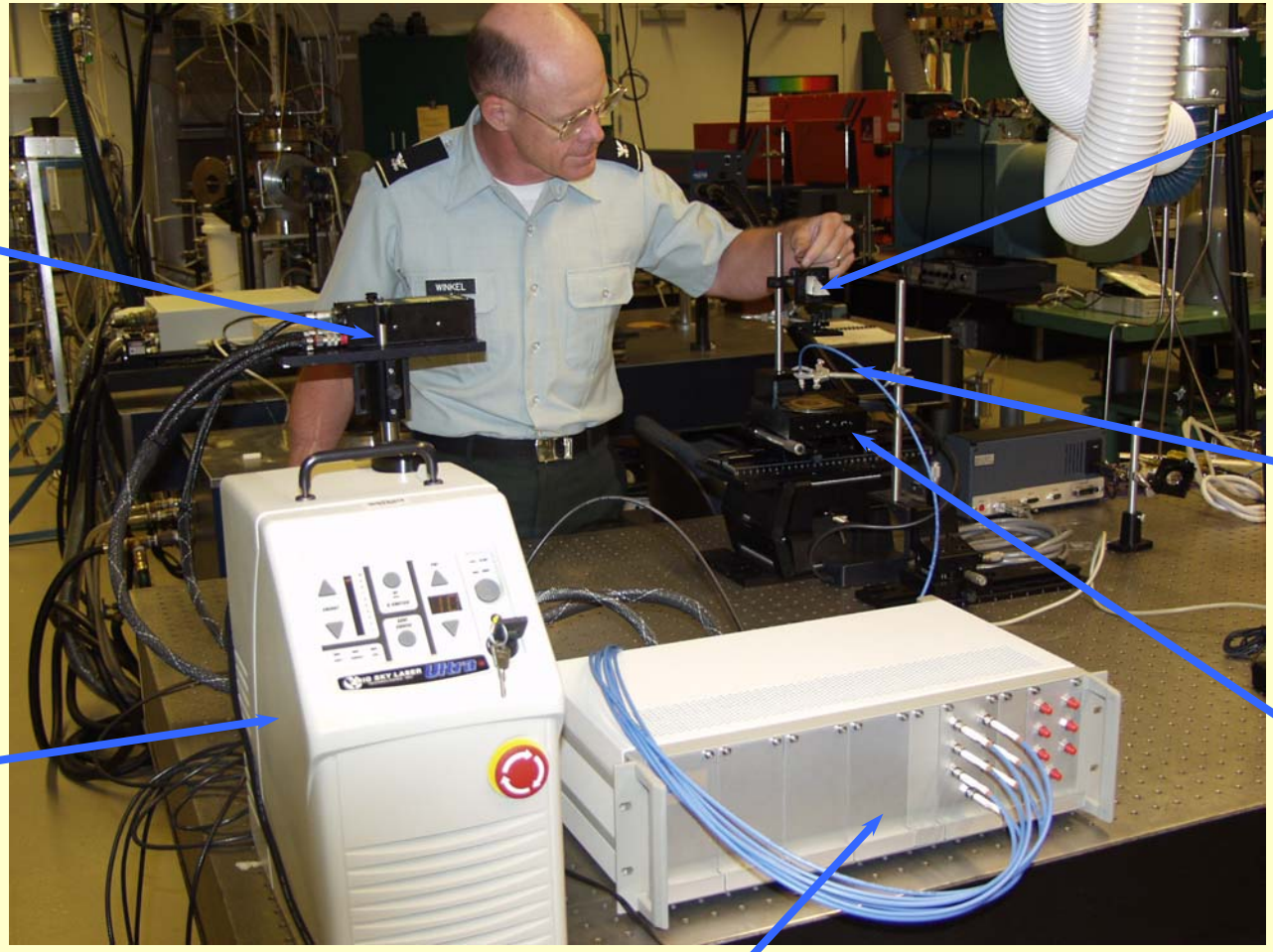




System Characteristics

- 7 high-resolution spectrometers
- Spectral range 200-980 nm
- Spectral resolution of 0.1 nm
- Precise triggering with 500 nanosecond temporal resolution
- 14,336 discrete spectral elements/CCD pixels
- Real-time response up to 10 Hz
- Rugged and robust design

LIBS

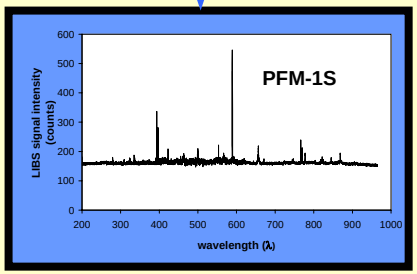

Laser Head
Focusing Optics
Fiber Optic Pickup
Laser Power Supply
Sample Stage
OOI LIBS 2000+ 7 Spectrometer System

LIBS Analysis of a Landmine Casing

fiber optic pickup

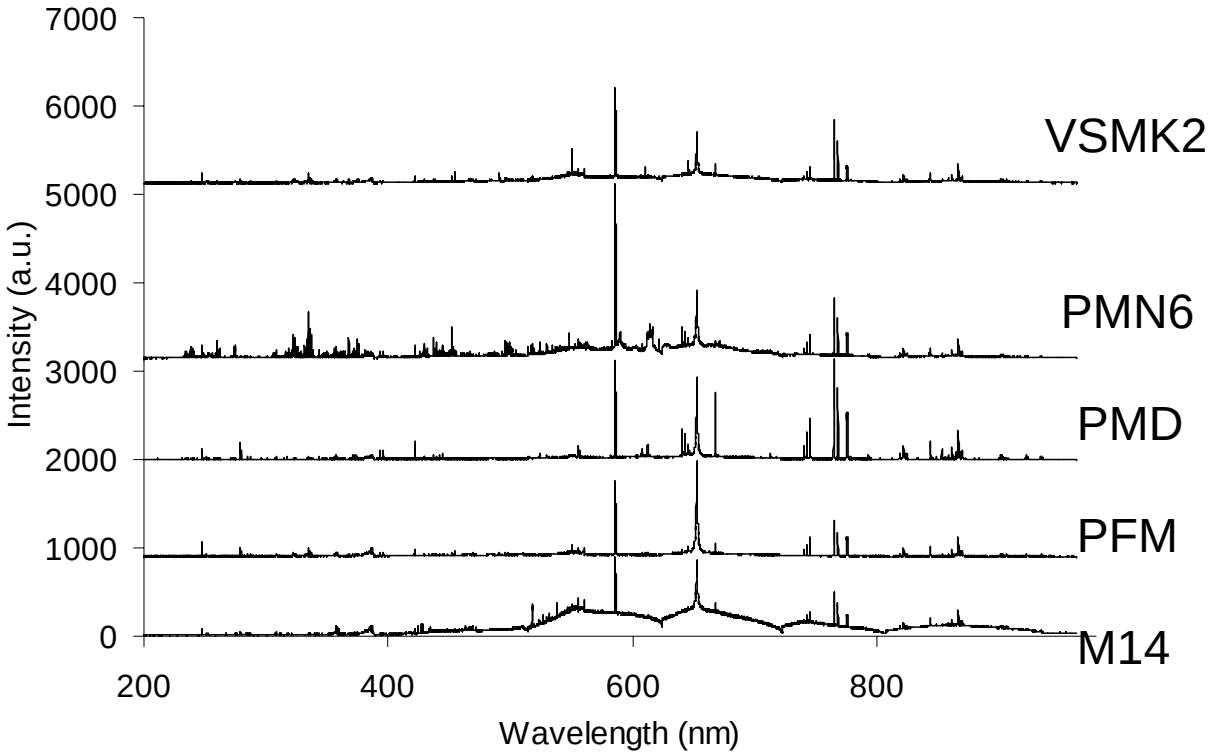
PFM-1S "butterfly" AP mine

LIBS Spectrum

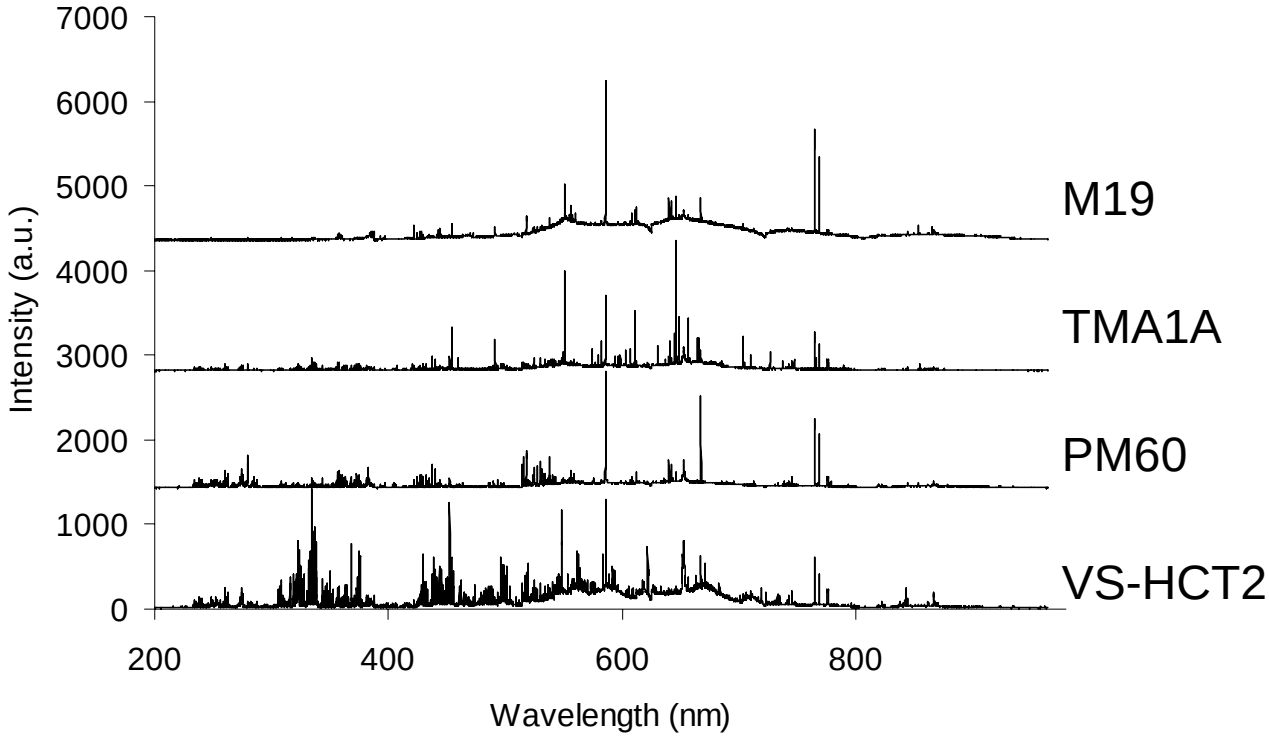


LIBS

LIBS spectra of different types of antipersonnel landmine casings



LIBS spectra of different types of antitank landmine casings



Results from LIBS analysis of landmine casings

	# LIBS analyses	# correct 'mine/no-mine' determinations	# correct mine or material type determinations	# correct specimen identifications
TEST #1				
landmine casings	56	53	45	29
plastics	24	20	19	16
wood & cardboard	5	5	5	4
rocks	5	5	5	3
metal	10	10	8	8
TEST #2				
landmine casings	54	49	42	25
plastics	21	19	14	12
wood & cardboard	6	6	4	4
rocks	10	10	9	3
metal	9	9	8	1

A Field-Portable LIBS Sensor

Characteristics

- Compact - briefcase size or smaller
- Portable power
- Rugged and robust
- Real-time response
- No sample preparation
- Good performance
  (high sensitivity & nanogram or lower detection limits)
- Standoff detection
- Low cost

A prototype of the man-portable LIBS system